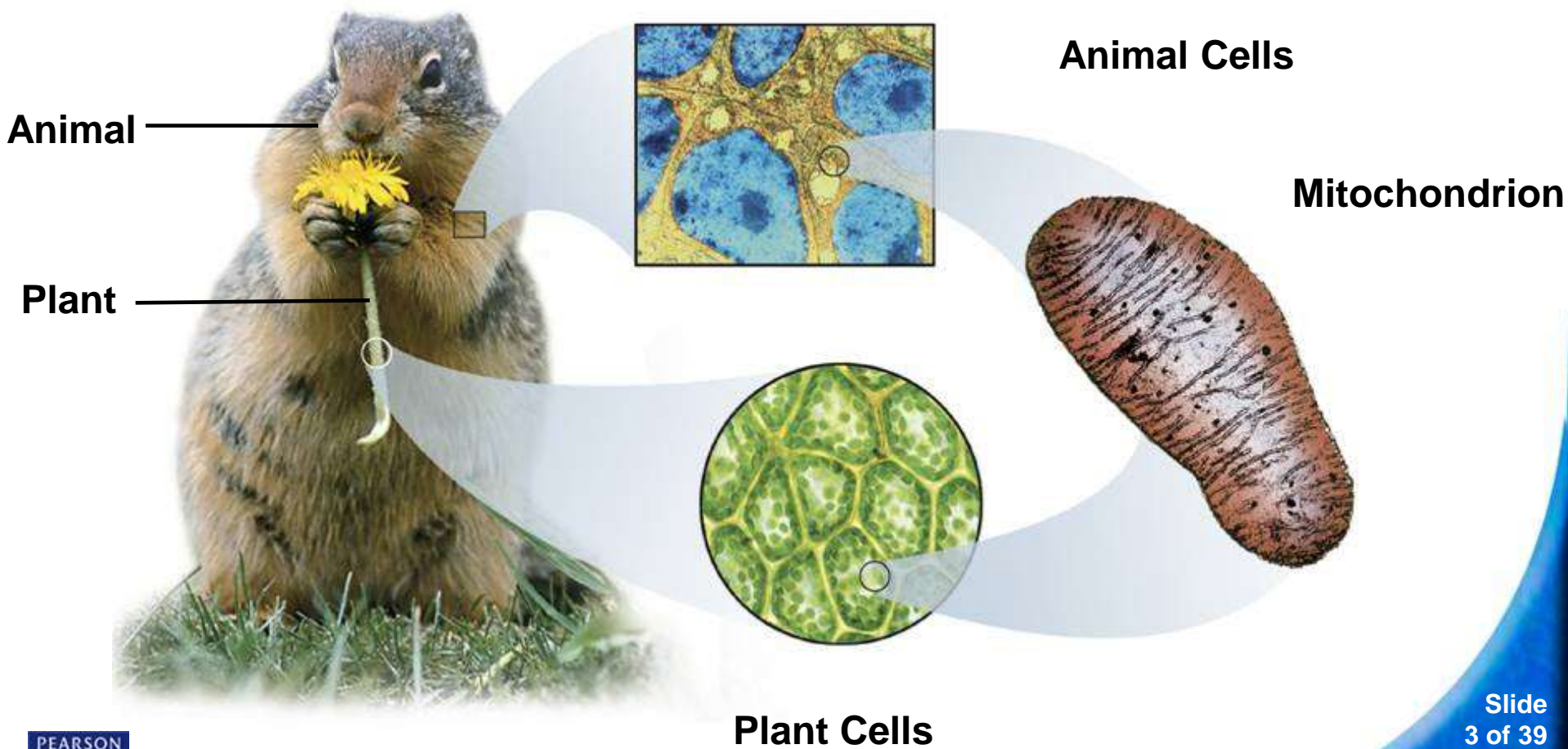


9-1 Chemical Pathways

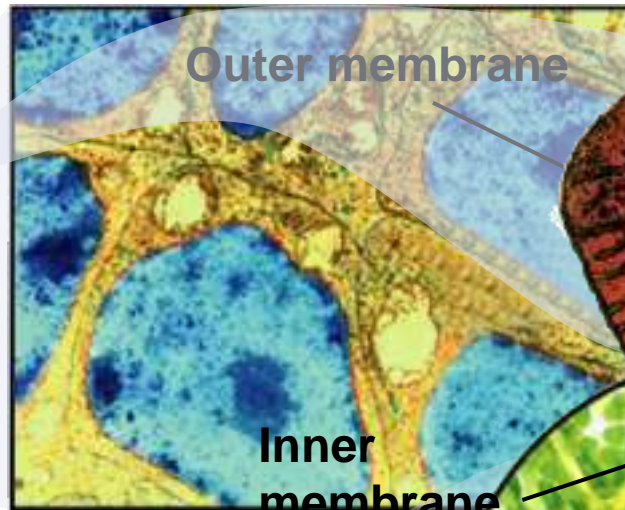


Food serves as a source of raw materials for the cells in the body and as a source of energy.

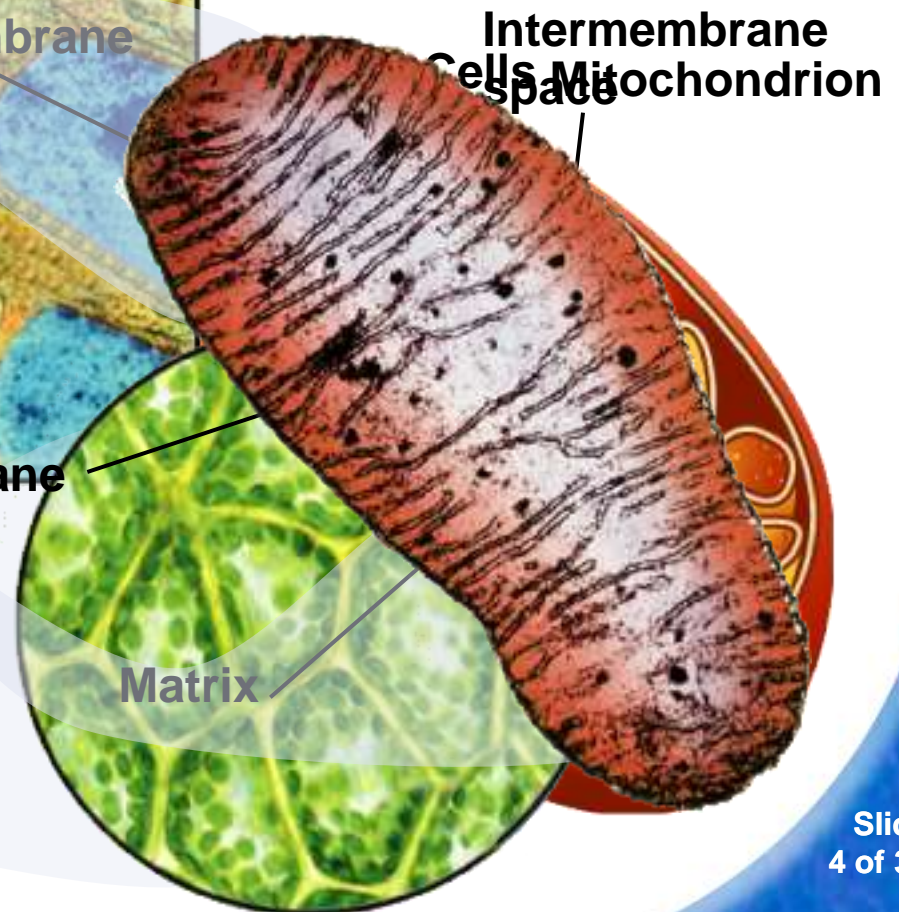


9-1 Chemical Pathways

Both plant and animal cells carry out the final stages of cellular respiration in the mitochondria.



Plant Cells



Chemical Energy and Food

One gram of the sugar glucose ($\text{C}_6\text{H}_{12}\text{O}_6$), when burned in the presence of oxygen, releases 3811 calories of heat energy.

A **calorie** is the amount of energy needed to raise the temperature of 1 gram of water 1 degree Celsius.

Cells don't “burn” glucose. Instead, they gradually release the energy from glucose and other food compounds.

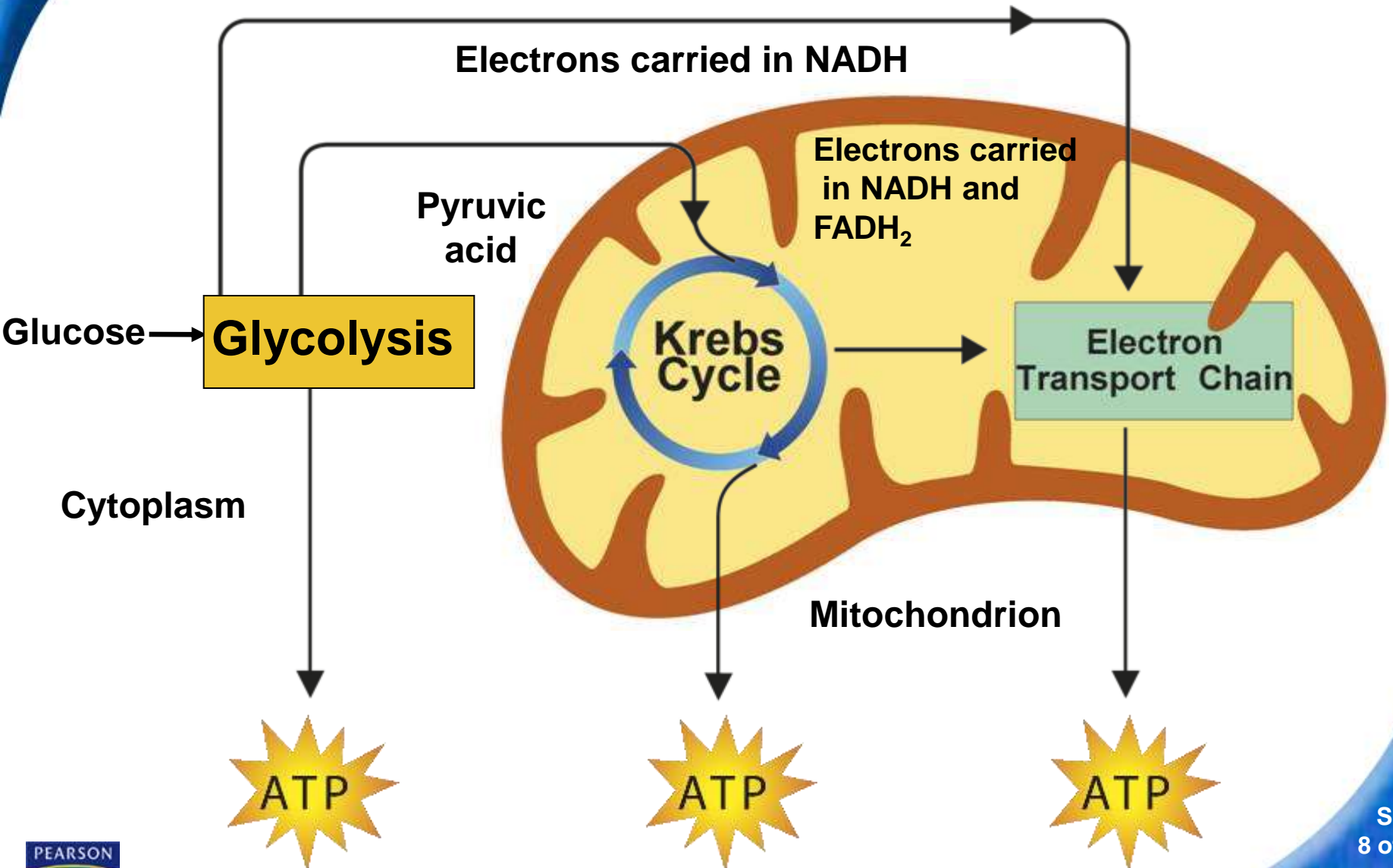
This process begins with a pathway called **glycolysis**.

Glycolysis releases a small amount of energy.
(2 ATP)

Overview of Cellular Respiration

If oxygen is present, glycolysis is followed by the Krebs cycle and the electron transport chain.

Glycolysis, the Krebs cycle, and the electron transport chain make up a process called **cellular respiration**.

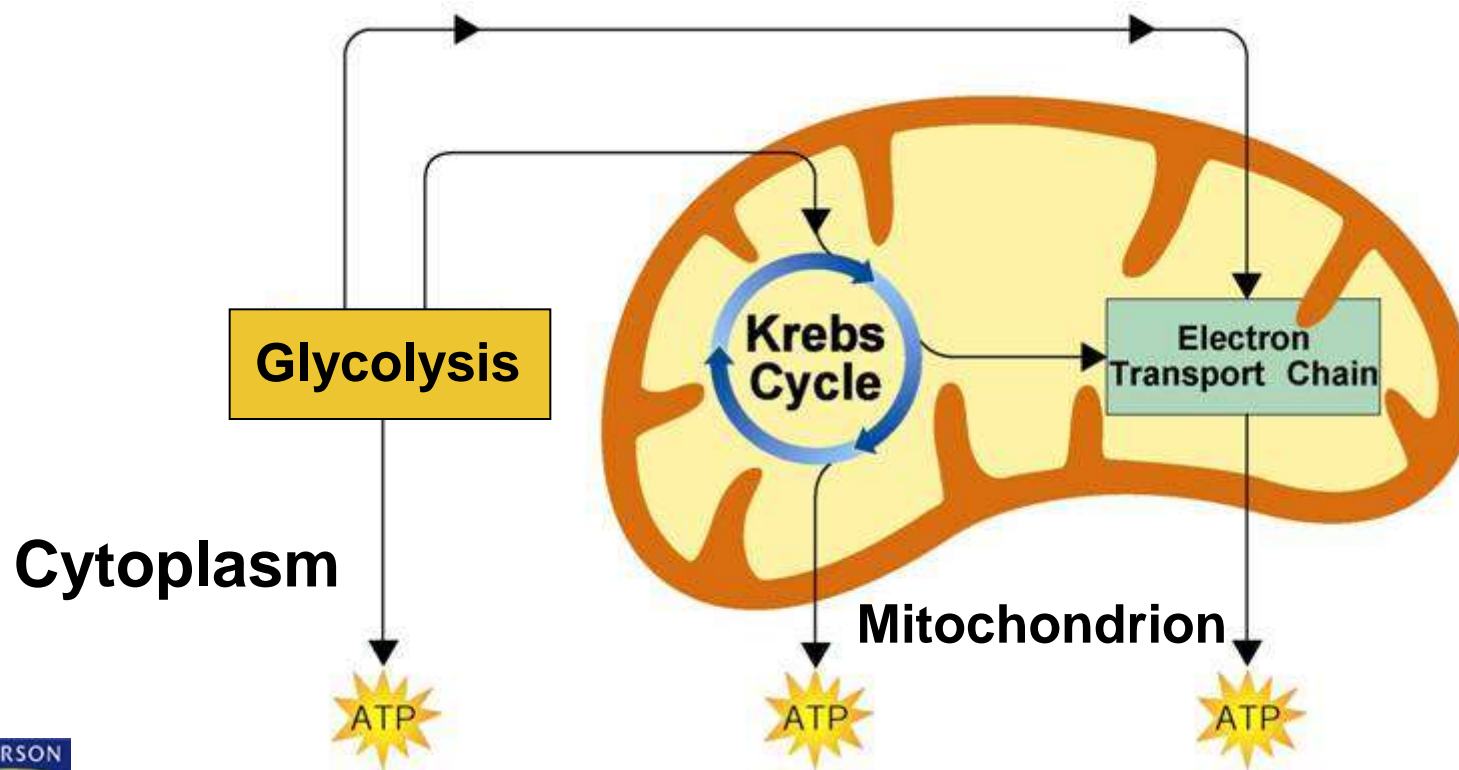




Cellular respiration is the process that releases energy by breaking down glucose and other food molecules in the presence of oxygen.

- The equation for cellular respiration is:
- $6\text{O}_2 + \text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{ATP}$
- oxygen + glucose \rightarrow carbon dioxide + water + energy

Glycolysis takes place in the cytoplasm. The Krebs cycle and electron transport take place in the mitochondria.



Glycolysis



Glycolysis is the process in which one molecule of glucose is broken in half, producing two molecules of pyruvic acid, a 3-carbon compound.

The Advantages of Glycolysis

The process of glycolysis is so fast that cells can produce thousands of ATP molecules in a few milliseconds.

Glycolysis does not require oxygen.

Fermentation

When oxygen is not present, glycolysis is followed by a different pathway. The combined process of this pathway and glycolysis is called fermentation.

Fermentation releases energy from food molecules by producing ATP in the absence of oxygen.

During fermentation, cells convert NADH to NAD⁺ by passing high-energy electrons back to pyruvic acid.

This action converts NADH back into NAD⁺, and allows glycolysis to continue producing a steady supply of ATP.

Fermentation does not require oxygen—it is an **anaerobic** process.

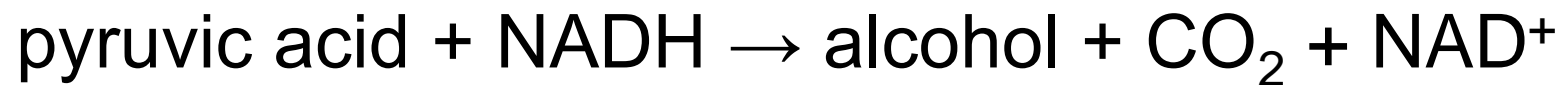


The two main types of fermentation are lactic acid fermentation and alcoholic fermentation.

Alcoholic Fermentation

Yeasts and a few other microorganisms use alcoholic fermentation, forming ethyl alcohol and carbon dioxide as wastes.

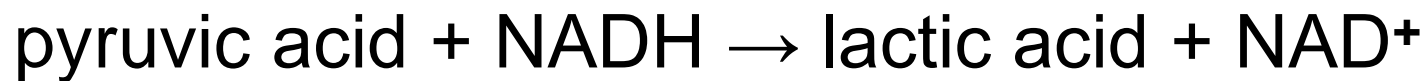
The equation for alcoholic fermentation after glycolysis is:



Lactic Acid Fermentation

In many cells, pyruvic acid that accumulates as a result of glycolysis can be converted to lactic acid.

This type of fermentation is called lactic acid fermentation. It regenerates NAD^+ so that glycolysis can continue.



9-1 Section QUIZ

Continue to:

Section QUIZ

- or -

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9-1 Section QUIZ

1 The raw materials required for cellular respiration are

- a. carbon dioxide and oxygen.
- b. glucose and water.

A

c. glucose and oxygen.

d. carbon dioxide and water.

9-1 Section QUIZ

2 Glycolysis occurs in the

a. mitochondria.

A b. cytoplasm.

c. nucleus.

d. chloroplasts.

9-1 Section QUIZ

3

The net gain of ATP molecules after glycolysis is

a. 3 ATP molecules.

A

b. 2 ATP molecules.

c. 3 pyruvic acid molecules.

d. 4 pyruvic acid molecules.

9-1 Section QUIZ

4 Fermentation releases energy from food molecules in the absence of

A a. oxygen.

b. glucose.

c. NADH.

d. alcohol.

9-1 Section QUIZ

5 The first step in fermentation is always

- a. lactic acid production.
- b. the Krebs cycle.

A c. glycolysis.

- d. alcohol production.

END OF SECTION